

Irrigation and Nitrogen Management Web-Based Tool for Lettuce Production

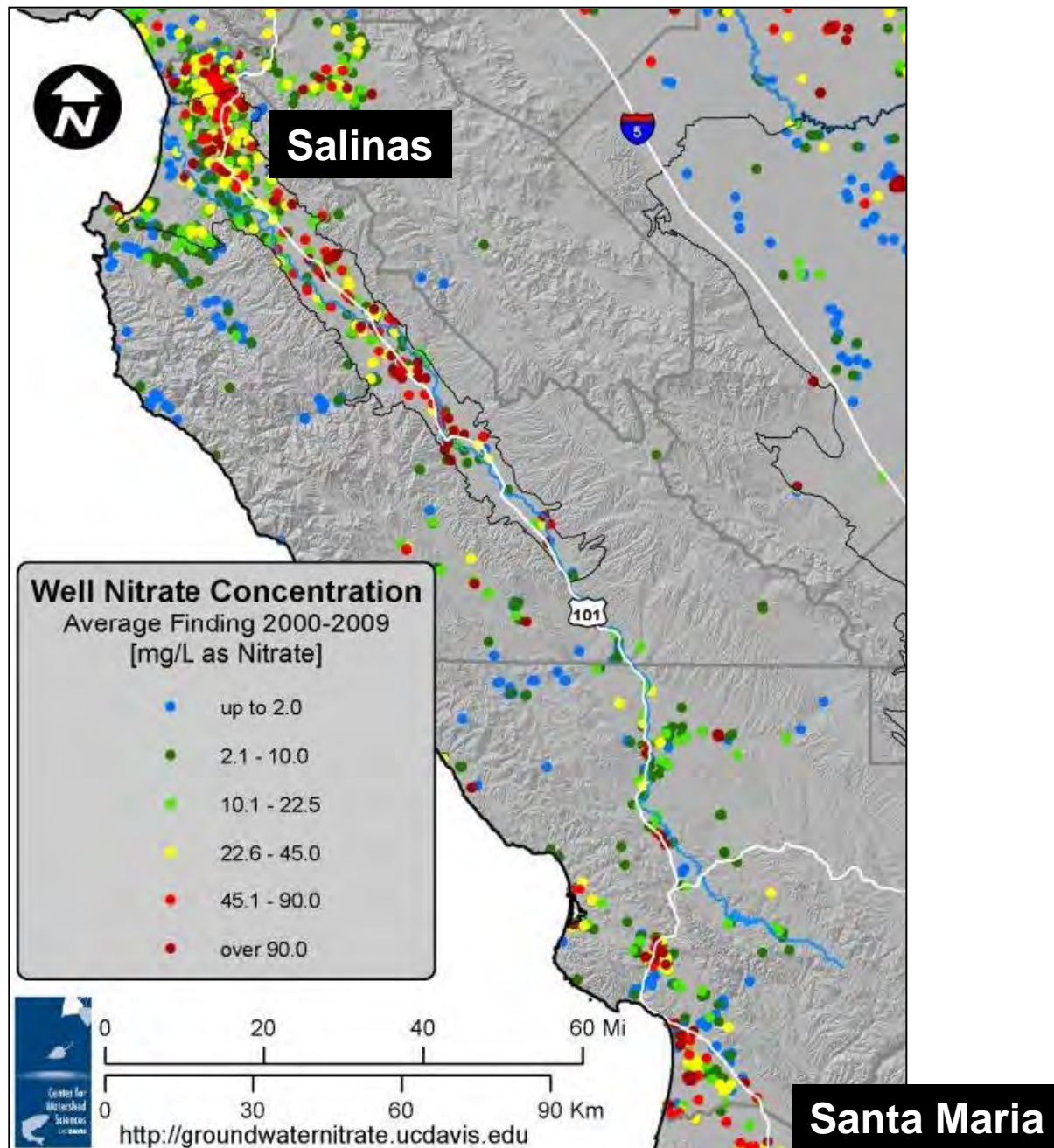


Michael Cahn
Irrigation and Water Resources Advisor
University of California, Cooperative, Monterey Co

Acknowledgements

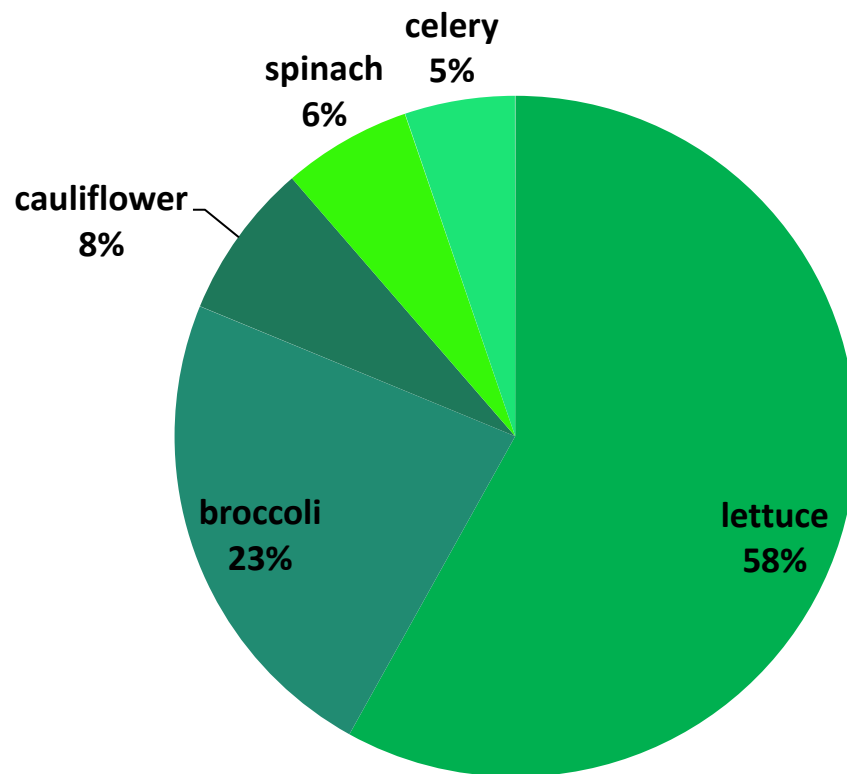
- Richard Smith, UC Farm Advisor, Monterey County
- California Department of Food and Agriculture,
Fertilizer Research and Education Program
- UC ANR Communication Services, Bryon Noel
- Grower participants
- Chiquita FreshExpress
- Tanimura and Antle

The Central Coast has serious nitrate issues :



Coastal Valleys :

- Wall-to-wall vegetable crops
- 2-3 crops per year



Ways to improve nitrogen use efficiency :

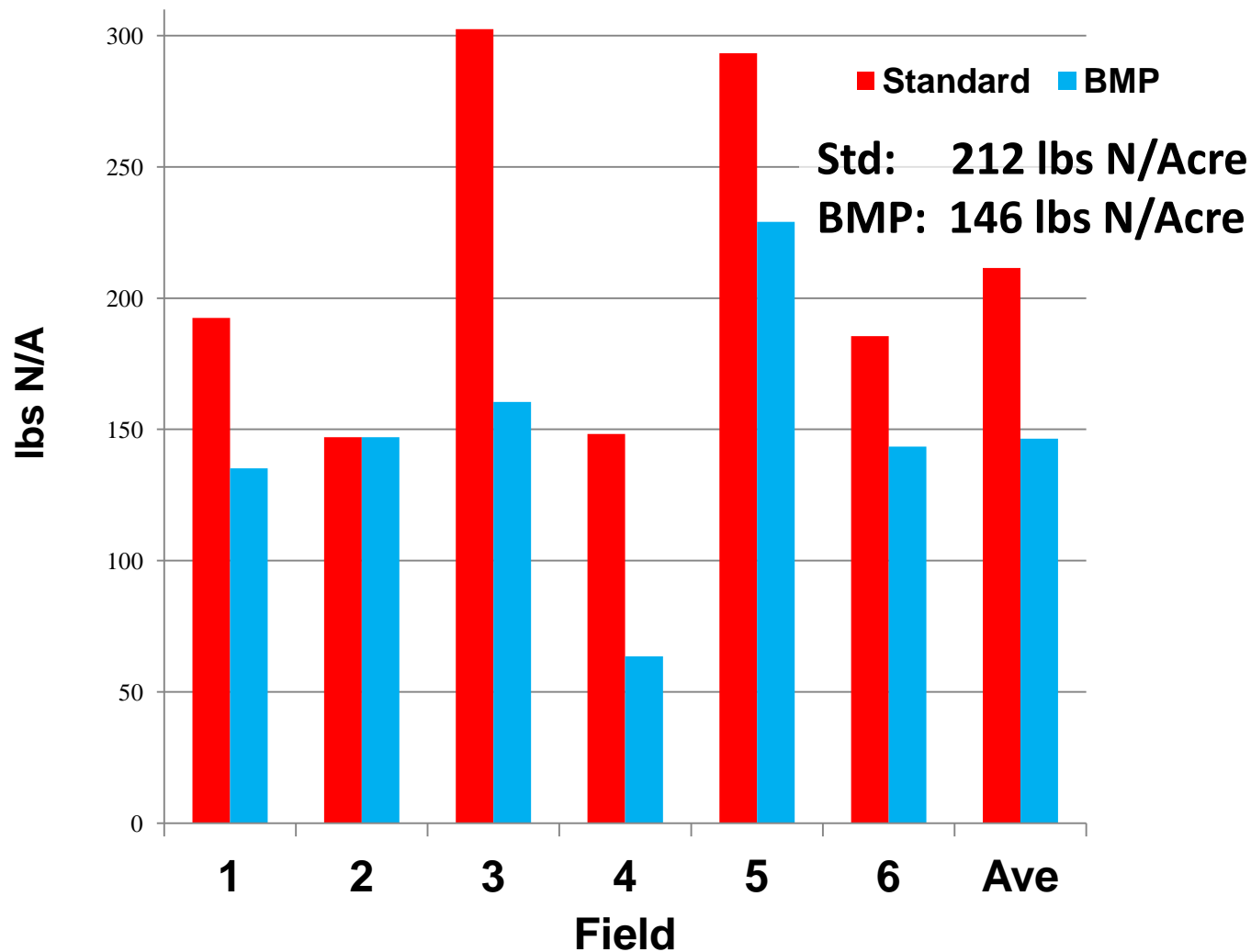
- Factor residual soil nitrate into fertilizer calculations



Pre-sidedress soil nitrate testing :

- 20 PPM $\text{NO}_3\text{-N}$ threshold enough to carry crop for several weeks

Applying PSNT on a field scale :



Difference
66 lbs N/A

Ways to improve nitrogen use efficiency :

- Use evapotranspiration-based irrigation scheduling



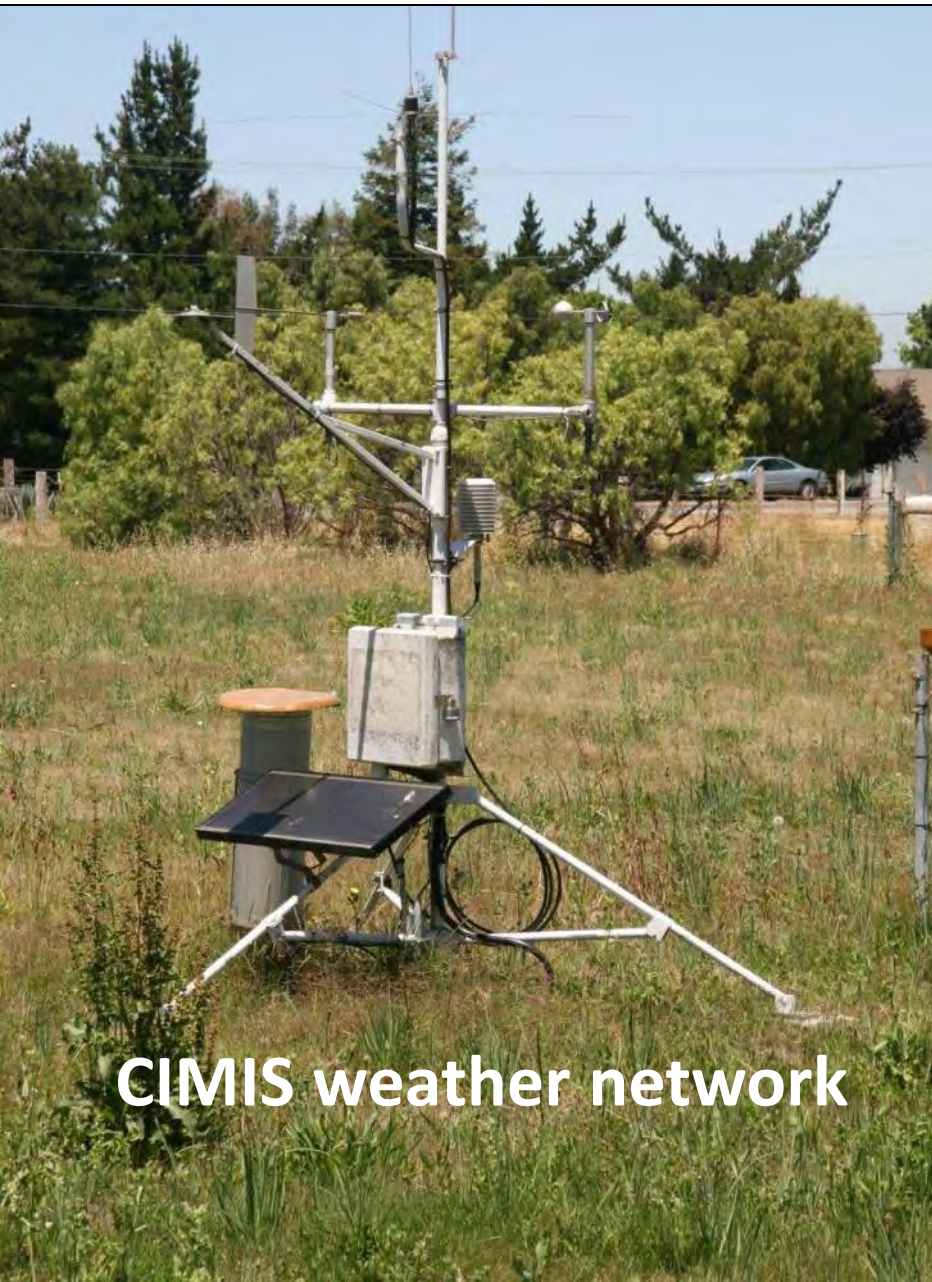
CIMIS weather network

ET-based Irrigation Scheduling

Converting Reference ET to
Crop ET:

$$ET_{\text{crop}} = ET_{\text{ref}} \times K_{\text{crop}}$$

K_c can vary from 0.1 to 1.2

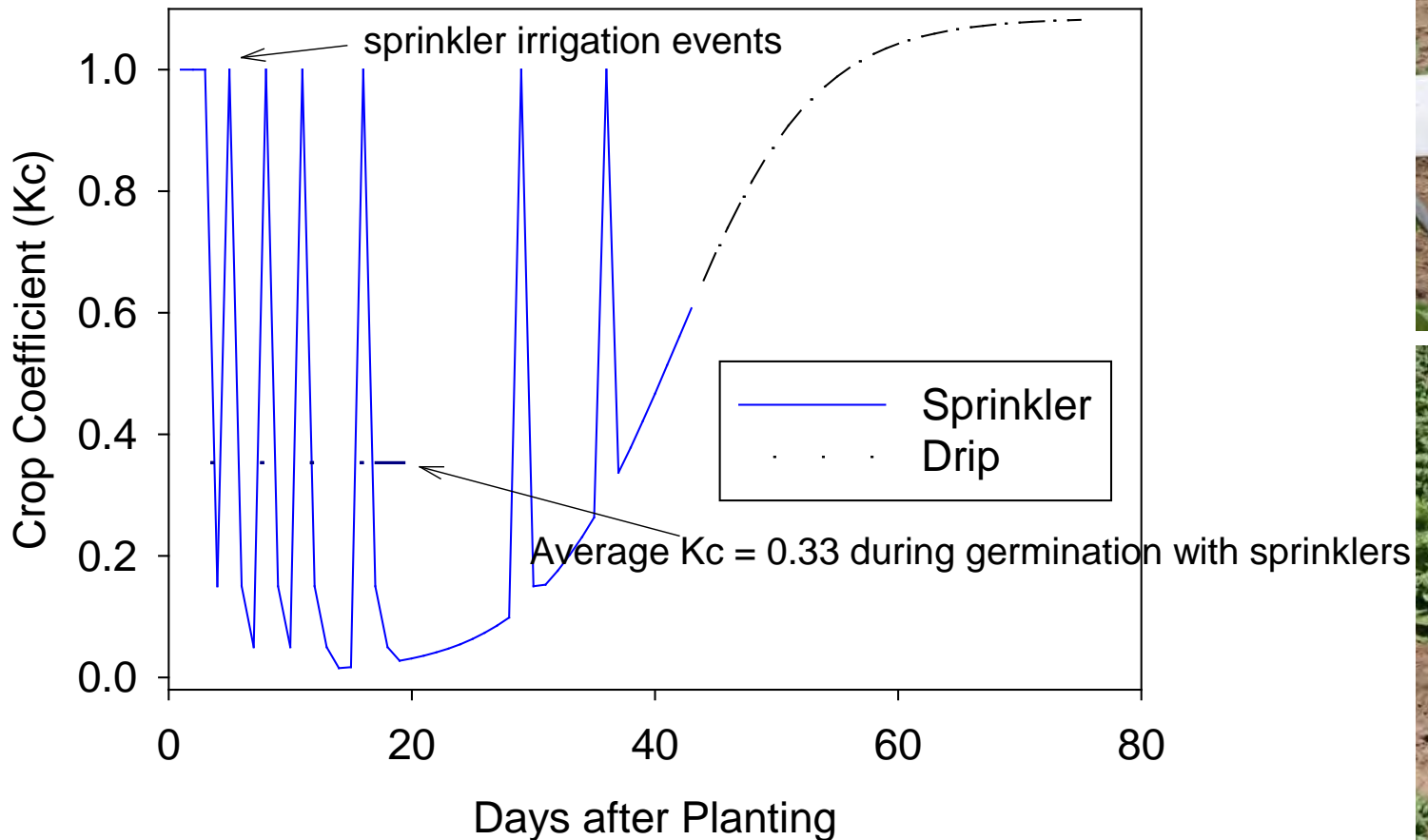


CIMIS weather network

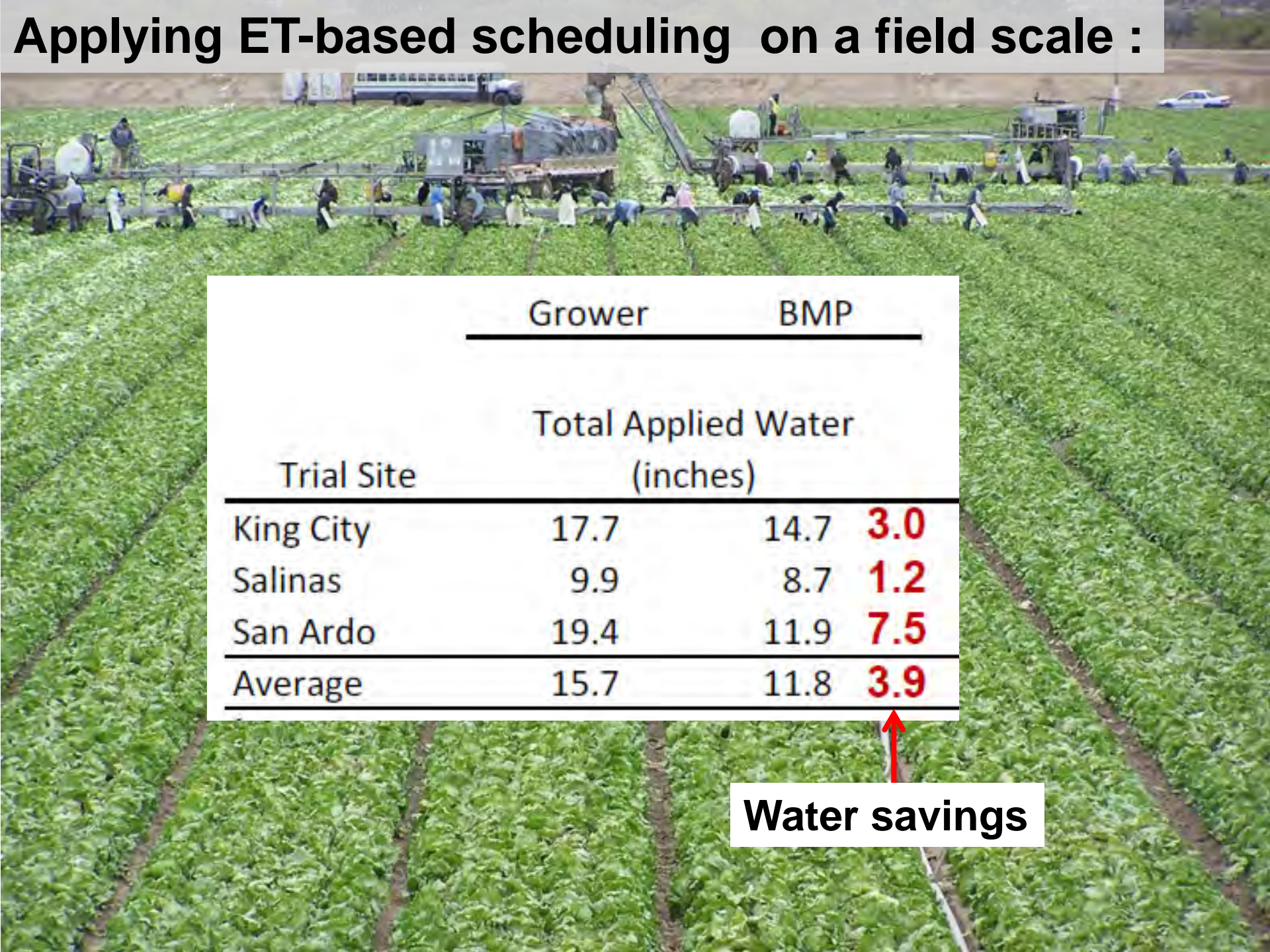
29 DAP

41 DAP

Estimated Kc of Lettuce



47 DAP




Applying ET-based scheduling on a field scale :

	Grower	BMP	
	Total Applied Water		
Trial Site	(inches)		
King City	17.7	14.7	3.0
Salinas	9.9	8.7	1.2
San Ardo	19.4	11.9	7.5
Average	15.7	11.8	3.9


Water savings

So why don't growers uniformly adopt these practices ?

- 
- One farm manager may be responsible for >100 fields during a production season
 - Irrigation and fertilizer management must fit with other activities (tillage, pest management, personnel management, equipment constraints)
 - Potential crop value overwhelms fertilizer and irrigation costs

Web-based Irrigation and N management software for lettuce

<https://ucanr.edu/cropmanage>

The logo for CropManage, featuring the text "CropManage" in a bold, white, sans-serif font. The background of the logo is a dark, horizontal band with a green, leafy texture on the right side.

[About CropManage](#)

Login

To login enter your e-mail and password below.

E-mail Address



Password

Login

[Forgot Password](#)

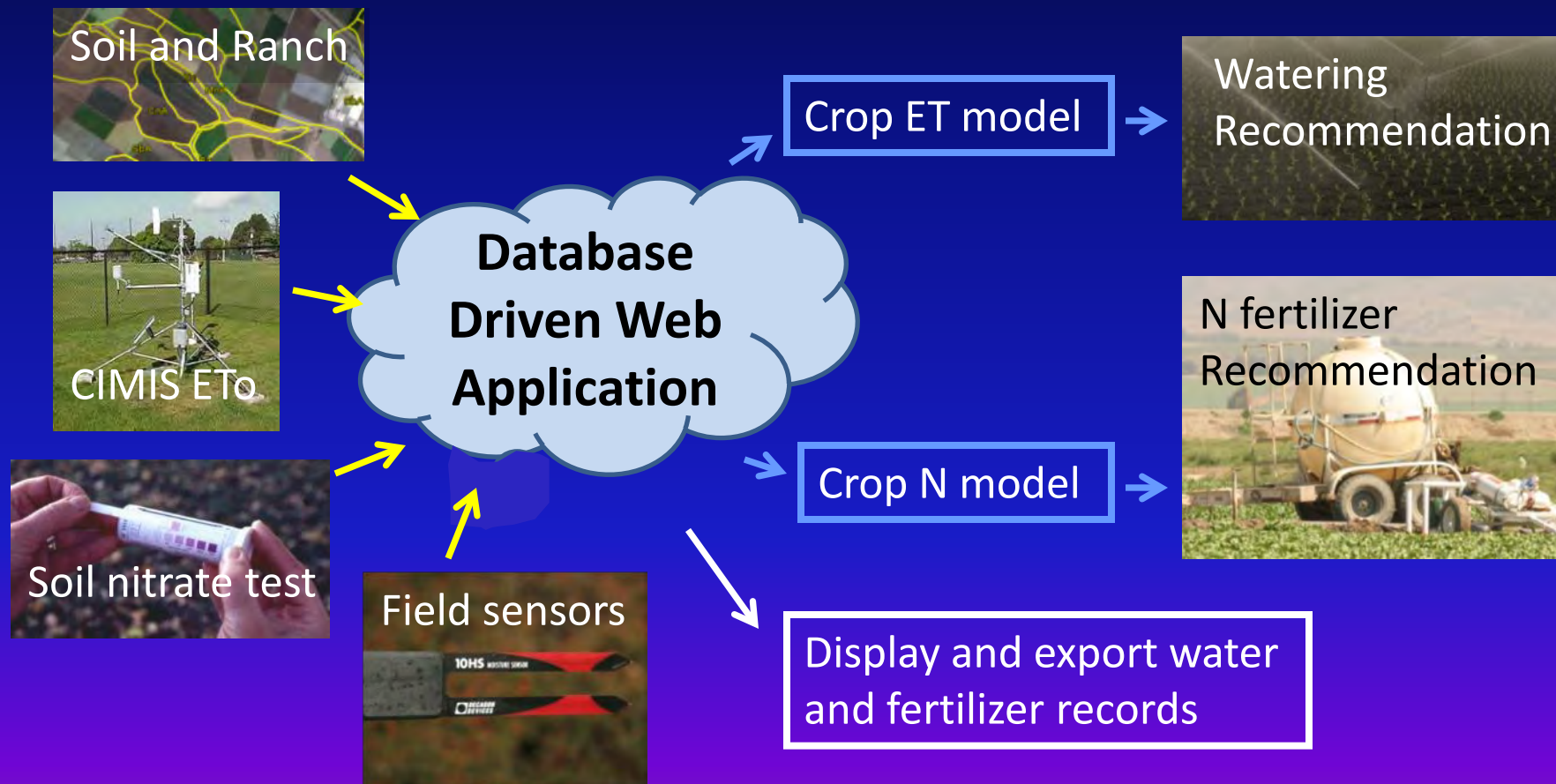
[Create New Account](#)

CropManage Web-based Tool:

Assist growers in making decisions on irrigation and nitrogen fertilizer management

- ✓ Intuitive, simple, quick to use.
- ✓ Accessible from smart phone, tablet computer, desktop computer
- ✓ Guide irrigation schedules using CIMIS weather data.
- ✓ Guide nitrogen fertilization decisions using soil nitrate test data.
- ✓ Maintain and share irrigation, fertilizer, and soil test records for multiple fields and farms.

Integrate information from multiple sources



Decision support using crop models

How is N fertilizer rate determined from a soil nitrate test?

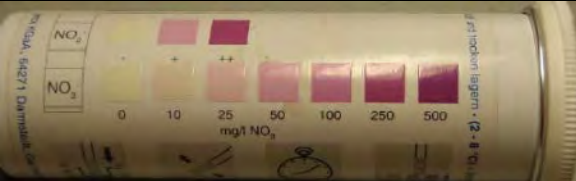
Recommended

Fertilizer N = Future Crop N uptake

– (residual $\text{NO}_3\text{-N}$ - threshold $\text{NO}_3\text{-N}$)

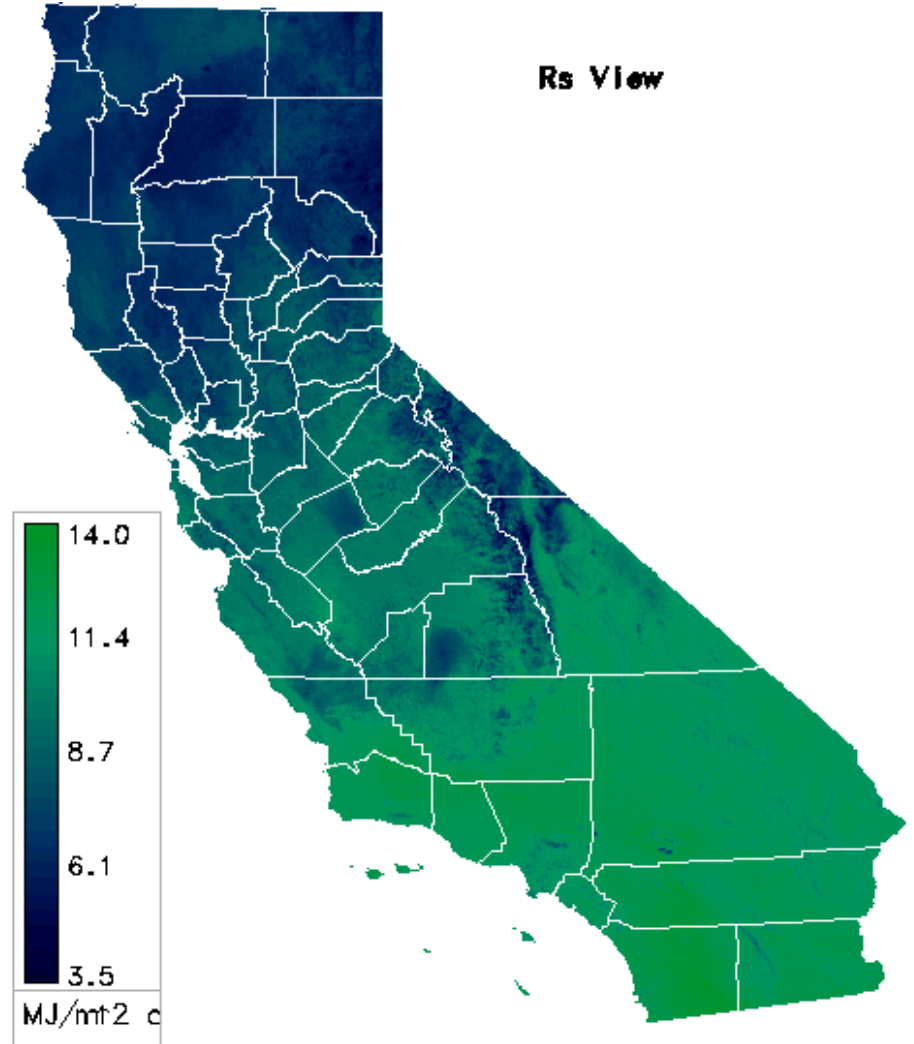
– Soil N mineralization potential

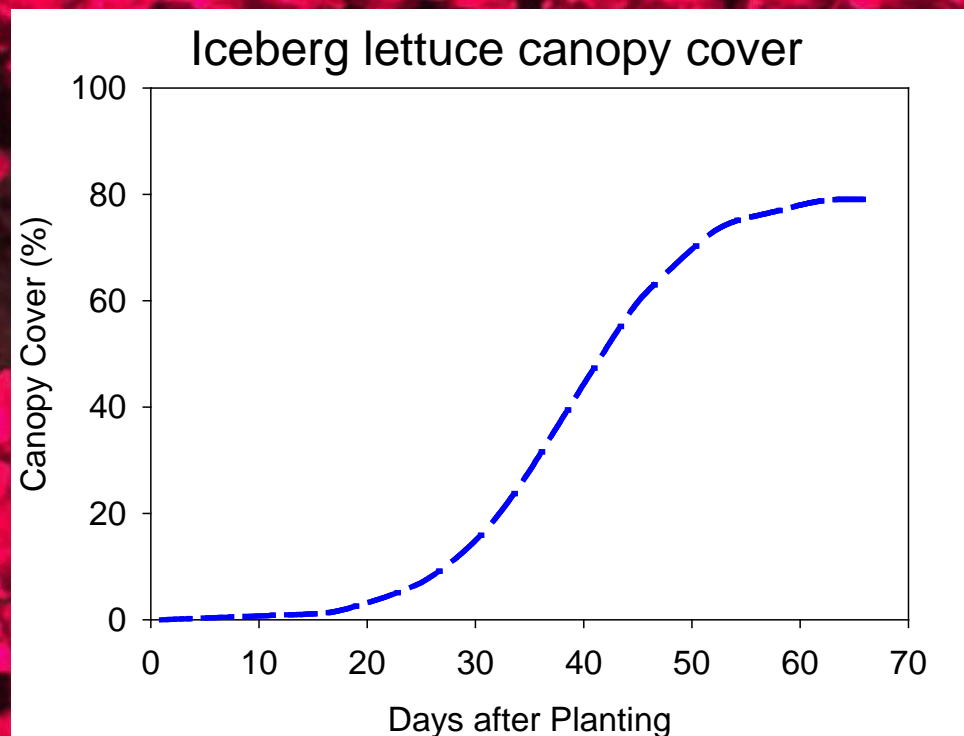
Soil $\text{NO}_3\text{-N}$ by 'quick test' or lab analysis



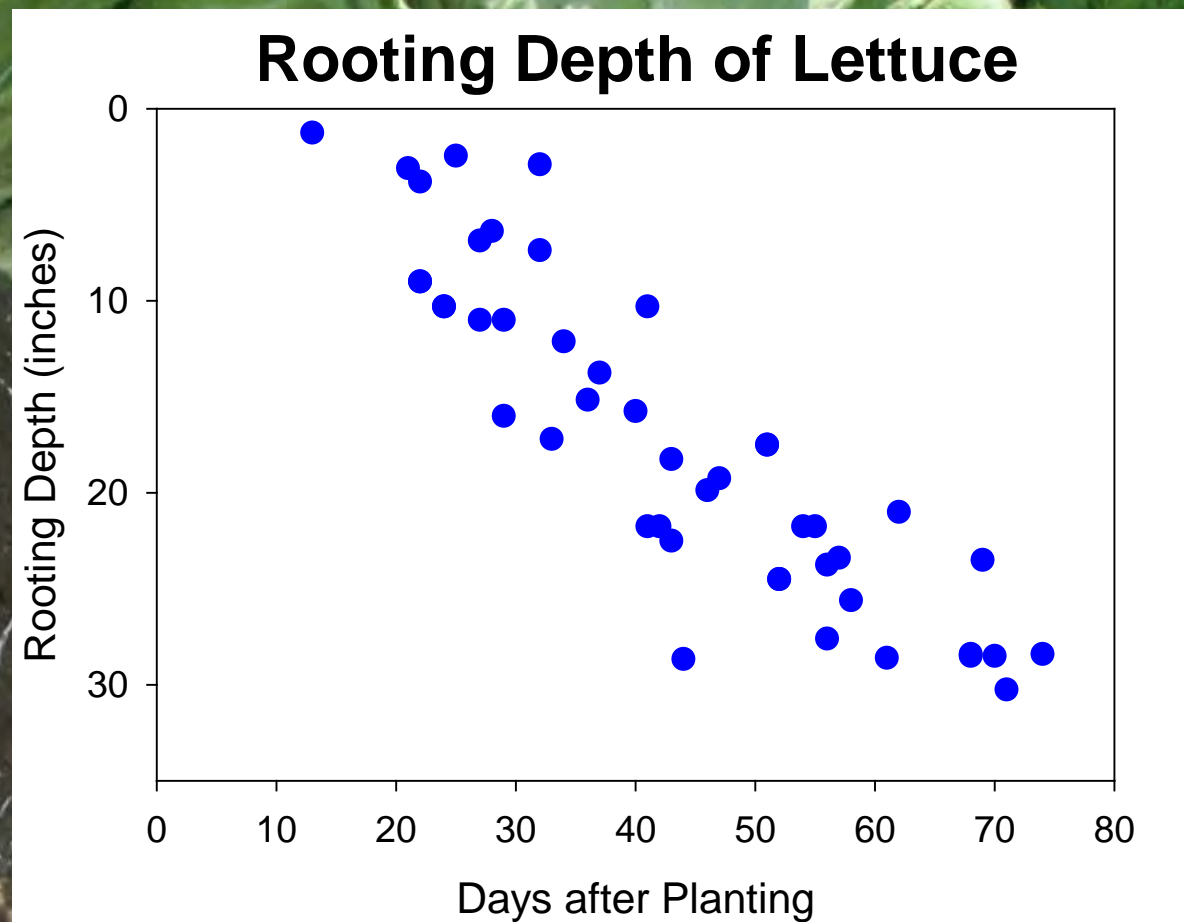
How is irrigation requirement determined?

Spatial CIMIS ET₀ Reporting





**Available moisture depends on soil type and
rooting depth**



Interface with UCD SoilWeb Tool

Soil Type

The screenshot shows the Soil Web App interface. At the top, there are two buttons: "Select Soil Type" and "Find Soil Type". The main area is a satellite map of a rural landscape with various colored fields. A red pin is placed on the map, and a white popup box displays soil data for that location. The popup includes the following information:

- Soil Name:** Elder sandy loam, 0 to 2 percent slopes
- Soil Series:** Elder
- Soil Texture:** sandy loam

Below this information is a table showing soil properties at different depths:

Soil Depth	Silt (%)	Sand (%)	Clay (%)	Organic (%)	Density (g/cm ³)	Soil Tension (cbar)	Mineralization Rate (lb N/acre/day)
1 ft	19.6%	67.4%	13%	2.5%	1.6	7	0.2
2 ft	19.6%	67.4%	13%	2.5%	1.6	5.8	0.2

On the left side of the map, there is a vertical scale bar with a red pin icon at the top and a white plus sign at the bottom. The map also shows several roads, including "Bardin Rd", "Old Stage Rd", and "Ainsal Rd".

Interface with field sensors :



Ranch Summary

CropManage

Ranch Home Edit Ranch Ranch List Site Administration Help Español Edit Profile Logout

Ranch/Field: USDA-ARS Spence

Plantings

Showing ALL Plantings

Planting	Wet Date	Harvest Date	Lot	Action
CSUMB broccoli trt1	7/27/2012	10/26/2012	4N	View View Details Edit
CSUMB broccoli trt2	7/27/2012	10/26/2012	4N	View View Details Edit
CSUMB broccoli trt3	7/27/2012	10/26/2012	4N	View View Details Edit
CSUMB trt1	5/4/2012	7/10/2012	4N	View View Details Edit
CSUMB trt2	5/4/2012	7/10/2012	4N	View View Details Edit
CSUMB trt3	5/4/2012	7/10/2012	4N	View View Details Edit
mOasis Head Lettuce	8/3/2012	10/17/2012	4N	View View Details Edit
Michelmore 130%ET High N	6/22/2012	8/25/2012	5N	View View Details Edit
Michelmore 50%ET High N	6/22/2012	8/25/2012	5N	View View Details Edit

Soil Summary

Sample Date	Sample Reading (ppm)	Crop Stage	Sample Depth (ft)	Sample Analysis	Soil Nitrate-N (ppm)	Soil Mineral N (lb/acre)
9/4/12	25	1st drip fertigation	1	Quick Strip	11.90	45.23
9/17/12	50	2nd drip fertigation	1	Quick Strip	23.81	90.46
9/21/12	50	3rd drip fertigation	1	Quick Strip	23.81	90.46
10/4/12	25	4th drip fertigation	1	Quick Strip	11.90	45.23
10/4/12	25	4th drip fertigation	2	Quick Strip	11.90	45.23
10/9/12	20	4th drip fertigation	1	Quick Strip	9.52	36.18
10/9/12	15	4th drip fertigation	2	Quick Strip	7.14	27.14

Fertilizer Summary

Fertilizer Date	Soil NO ₃ -N (ppm)	Crop Stage	Fertilizer N Recommended (lb N/acre)	Cumulative N Uptake	Fertilizer	Applied N (lb N/acre)	Applied Fertilizer
7/24/12	N/A	Bed listing	N/A	0.00	6-20-20	18.0	300.0 lbs/acre
8/20/12	N/A	Post-thinning	N/A	5.31	Ammonium Sulfate	63.0	300.0 lbs/acre
9/7/12	11.90	1st drip fertigation	47.8	15.15	UAN32	40.0	11.3 gallons/acre
9/18/12	23.81	2nd drip fertigation	0.0	26.27	UAN32	40.0	11.3 gallons/acre
9/24/12	N/A	3rd drip	N/A	34.99	KTS	0.0	10.7 gallons/acre

Water Summary Table

Water Date	Irrigation Method	Recommended Irrigation Interval (days)	Recommended Irrigation Amount (inches)	Recommended Irrigation Time (hours)	Irrigation Water Applied (inches)	Kc	Canopy Cover (%)	Average Reference ET (inches/day)
7/27/12	sprinkler	N/A	N/A	N/A	1.52 in	0.00	0	0.00
7/29/12	Sprinkler	1.0	0.35 in	1.18 hrs	0.77 in	0.70	1	0.19
7/31/12	Sprinkler	1.0	0.37 in	1.23 hrs	0.95 in	0.70	1	0.20
8/2/12	Sprinkler	1.0	0.36 in	1.20 hrs	0.29 in	0.70	1	0.19
8/6/12	Sprinkler	2.2	0.34 in	1.14 hrs	0.35 in	0.37	2	0.17
8/10/12	Sprinkler	1.8	0.41 in	1.38 hrs	0.45 in	0.37	3	0.21
8/14/12	Sprinkler	2.8	0.41 in	1.37 hrs	0.56 in	0.38	5	0.20
8/24/12	Drip	6.5	0.53 in	3.80 hrs	0.54 in	0.25	15	0.18
8/28/12	Drip	14.4	0.16 in	1.13 hrs	0.15 in	0.28	23	0.12
8/31/12	Drip	8.1	0.24 in	1.71 hrs	0.22 in	0.37	31	0.19
9/4/12	Drip	7.6	0.37 in	2.63 hrs	0.39 in	0.49	43	0.16
9/7/12	Drip	6.8	0.34 in	2.43 hrs	0.55 in	0.62	53	0.16

Field Validation of CropManage

Treatment	<u>Applied water</u>		Commercial Yield
	sprinkler	drip ¹	
	inches		lbs/acre
Grower Standard	4.1	4.9	17935
CropManage	4.1	3.8	18389
¹ comparison was on last 7 irrigations			

Treatment	Applied N Fertilizer	Commercial Yield
	----- lbs per acre -----	
Grower Standard	211	19114
CropManage	149	18760

The road ahead...



Final Thoughts

- Web applications can repackaging complex data sets and mathematical models into simple to use decision support tools
- Web apps can also help growers track their practices and demonstrate they are managing nutrients and water efficiently
- *CropManage* is not just for growers. It is a potential tool for crop consultants and advisers to use in assisting growers with water and N management decisions.

